P-10.2 Explain the relationship among internal energy, heat, and work.

Revised Taxonomy Levels 2.7 B Explain conceptual knowledge

Students did not address this concept in physical science

It is essential for students to

- Be able to use the equation $Q = \Delta E + W$, where
  - Q = heat transferred to a system (in joules)
  - ΔE = the change in the internal energy of a system (in joules)
  - W = work done on surrounding objects (in joules)
- Understand that
  - Q is positive when energy is transferred to the system (and negative when energy is transferred out of the system)
  - W is positive when the system does work on surrounding objects (and negative when the surroundings do work on the system)
- Understand that a process in which no heat is added to or removed from a substance is called an adiabatic process
  - $Q = 0 = \Delta E + W$
  - $\Delta E = -W$
  - The work done on the system = the change in its internal energy

Assessment

The verb, explain means that the major focus of assessment should be for students to "construct a cause and effect model". In this case, assessments will ensure that students can model how heat affects the internal energy of a system and the work that that system can do on the surroundings. Because the indicator is written as conceptual knowledge, assessments should require that students understand the "interrelationships among the basic elements within a larger structure that enable them to function together." In this case, assessments must show that students can construct a cause and effect statement relating how changes in each of these three variables, heat, internal energy, and work affect the others.